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ROYAL SOCIETY OF ARTS.

Cantor Lectures

ON

THE HISTORY AND PRACTICE OF THE ART OF PRINTING.

BY

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Librarian, St. Bride Foundation Typographical Library.

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The History and Practice of the Art of Printing.

LECTURE I.—Delivered November 23rd, 1914.

Printing with moveable types was invented either in Holland or Germany about the year 1440. The name of the inventor and the place of the invention are two of the most hotly contested questions in history. Gutenberg at Mainz, Coster at Haarlem, Waldfoghel at Avignon, Castaldi at Feltre—all these are mentioned as claimants. The value of their respective pretensions has been summed up by a well-known authority in the words: "Holland has books but no documents, France has documents but no books, Italy has neither books nor documents, while Germany has both books and documents." There exist books certainly printed in Holland which are held by some to be earlier than 1454, which is the first printed date of the Mainz press. They are attributed to the press of Laurens Janszoon Coster of Haarlem, but this is not supported by any direct evidence. As to the Avignon claim, this rests upon some documents in the legal archives of the town. Waldfoghel, who was a goldsmith, was in the possession of a method of artificial writing which, by the description given, must have been printing. No work done by him or by his method has been identified.

The claim of Castaldi, of Feltre, appears to rest upon very shallow foundations, and, in fact, it is difficult to see anything but tradition in the story. When we turn to Mainz we are on more solid ground. From the first Mainz press—it is difficult to associate John Gutenberg definitely with it—a broadside Indulgence was issued with the printed date of 1454. Through the haze of tradition, theory and speculation, this Indulgence emerges as a definite fact, and from this date begins the real history of printing with moveable type. From what we know of the operations of typefounding to-day we can see that it must have taken many years of experiment and of failure to enable the printer of the 1454 Indulgence to arrive at the final solution of the problem. From the press of Mainz also was produced the first Latin Bible, originally known as the Mazarine Bible, afterwards described as the Gutenberg Bible, and now called by all good doubting bibliographers the forty-two line Bible, which title commits no one. This Bible was printed before August, 1456, as a copy in the Bibliothèque Nationale has a rubricator's date of that year. In 1457 appeared the Mainz Psalter, the first book to bear the name of its printer, the name of the place where it was printed, and the date of its production. To add to this, it contained the first attempts at colour printing and the first ornamental initials. The printers were Johann Fust and Peter Schöffer, and this Psalter, together with the other books from their press, showed a great advance from the work of the two first presses in Mainz.

The work of these pioneer printers must have been much hampered by the poverty of their implements. There is little doubt that the earliest press used was a simple linen-press, and a small one at that. The ink was an invention, if not in itself, in its application. With these poor instruments, and with type that must without doubt have been irregular and badly cast, the pioneers of the printing art produced the magnificent works which remained, perhaps unequalled, and certainly not surpassed, for many years.

From the Mainz press, with its colour-printed initials, we pass to Strassburg. Here as early as 1460, and perhaps two years earlier, Johann Mentelin was printing and using a type which began to show the first modification towards the round or Roman type. Everything up to this time had been printed in the type which is

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known generically as the Gothic or Black Letter type. About the year 1464 a press was established at Strassburg which used a definite Roman type. The printer, formerly known as the "R" printer, owing to the curious form of the capital R in the fount of type he used, and whose books were originally confused with those of Mentelin, is now identified as Adolph Rusch, the son-in-law of Mentelin. The first Roman type, therefore, is found in Germany, although we have to look to Italy for its later development. The next press to be mentioned as showing development in the art is that of Albrecht Pfister, of Bamberg. Pfister is a mysterious person, being connected in some way with the earliest presses in Mainz, and by some is looked upon as the printer of the thirty-six line Bible, which by most bibliographers is attributed to the printer of the 1454 Indulgence. The interesting point about Pfister is that seven out of the nine books from his press are illustrated with woodcuts, and form the first attempt at book illustration. None of them can be placed later than 1462. No more illustrated books occur until about 1470.

The next important event is the establishment of printing in Italy. Sweynheym and Pannartz, two German craftsmen, started work in Subiaco near Rome in 1465. They used a type which was not Gothic and not quite Roman, and is generally described as Semi-Roman. It was not based on the same style of writing as the first German Roman, as will be seen when the two are compared. Two years later, in 1467, when these printers moved to Rome, their type became still more Roman in character; but it was not until 1471 that the new character, which was really the older form of letter (this is recognised by the Germans, who to this day call it Antiqua), reached its highest point, in the type used by Nicolas Jensen, a Frenchman, who printed at Venice. This type, perfect in outline and balance, has held its artistic supremacy to the present day. The Roman type failed, however, in its competition with the Gothic, which held the field all over Europe during the fifteenth century.

Up to 1465 the Gothic and the Roman were the only type-faces in use. In that year Greek type was used by Sweynheym and Pannartz at Subiaco, and by Fust and Schöffer at Mainz. Previously a space had been left where a Greek quotation was required, and it had been written in by hand, or in some cases stamped in. The first book to contain a full Greek text was printed by Ferrandus at Brescia about 1473. It was the "Batrachomuomachia" of Homer, and the book also contained a Latin translation of the work. The development of Greek printing was rapid in Italy, but slow in the other countries of Europe.

Printing began in Switzerland about 1468 at Basel, and in 1470 in France at Paris. It is strange that Paris was so late introducing the printing press, as there is no doubt that specimens of the art had been seen there in 1466, and it is believed that Jensen was sent by Charles VII. to learn the new art as early as 1458. On his return to Paris, finding his patron, the king, dead, and encountering considerable opposition from the scribes and copyists, he went to Italy and ultimately established his press at Venice. The first Paris press was established under the patronage and by the exertions of professors of the University of Paris, and the press itself was set up within the precincts. The printers, of course, were Germans, and their work was largely reprints of classical texts. The Roman type used by these printers was of a very high artistic character, Mr. Gordon Duff, in fact, going so far as to say that it far surpasses Jensen's in beauty.

By 1473 printing was definitely established in the Low Countries, both Utrecht and Alost producing dated books in that year. In 1475 occurs the first use of Hebrew type. Piove di Sacco and Reggio di Calabria in Italy, and Esslingen in Germany, were the towns where it was first used. Many Hebrew presses were set up in Italy during the last quarter of the fifteenth century, and several in Spain and Portugal.

In 1475 the art reached Austria, and in the same year Spain. The first book printed in England was issued from the press of William Caxton in 1477. The false date 1468 appears in an Oxford edition of Rufinus on Jerome's exposition of the symbols of the Apostles. This date has given rise to a considerable amount of controversy. Richard Atkyns in 1664 alleged that this book was printed by Frederick Corsellis, a workman from the press of Haarlem, who was bribed to come to England by order of Henry VI. This story was based on a manuscript alleged to be in the Library at Lambeth Palace. No one, however, has seen that manuscript from Atkyns' time to the present day, and as it is certain that the book dated 1468 was printed in 1478 by the first Oxford printer, I think it may be taken that the existence of the said manuscript is very doubtful. However, the king (Charles II.) believed Atkyns' story and gave him the patent for law-

book printing. The press in England was not responsible for any great advance in the art—in fact, English printing of the fifteenth century was of a comparatively low order.

About 1481 or 1482 music is found printed with type. In 1473 a few notes were printed by C. Fyner at Esslingen. The principal use of music was in service books, and it was always printed in two impressions up to the end of the fifteenth century. The notes are generally in black and the stave lines in red. The earlier printers either left a blank space for the rubricator to write in the music, as in the 1457 Psalter, or in a few cases printed in the stave lines, leaving the notes to be added later by hand.

A further addition to the resources of the art was the cutting of Slavonic type, which is found in at least two varieties in Cracow in 1491 and at Cettinje, in Montenegro, before the close of the century. A Secretary type following closely the French law hand is found used at Paris and Rouen in the last decade of the century. A Rouen book printed for Richard Pynson, of London (Statham's Abridgment), is a good specimen of this type.

During the last few years of the century printing presses were established in Portugal, Denmark, Sweden, and Montenegro.

We have a picture of the printing press as improved by the close of the century in a "Dance of Death," printed at Lyons in 1499. A considerable change is seen from the plain screw-press of the earliest printers. It has assumed the familiar form of the wooden hand-press known to all. There is certainly a tympan. As to the frisket, it is distinctly probable that this valuable addition to the press was the invention of some one in the office of Schöffer at Mainz. It is most likely that the diminution of the number of pinholes in the sheet which occurs in the very early seventies is due to this addition to the press.

At the close of the fifteenth century the printer had almost emerged from the experimental stage. The press had assumed the form it was to hold with very slight alteration for 300 years. Books could be printed in Roman, and many varieties of Gothic types, in Hebrew, Greek or Slavonic letters, and music type (in two printings) was constantly used. Coloured inks were known, although very sparingly used. The technique of book-making had almost reached its height. The early books were without titlepages, tables of contents, pagination, imprint, signatures and illustrations. By the year 1500 all these had been introduced, and if they were not always used it was not because they were not known.

The Sixteenth Century.

With the opening of the sixteenth century the art enters upon a period of steady progress. It is true no great inventions either of machinery or methods were introduced, but the increase in the number of works issuing from the press was steady throughout the century.

The most noticeable change is the reduction in the size of books generally, and this occurred quite early in the century. As books became more popular and cheaper they naturally became smaller. The pocket volume, rare almost to non-existence in the fifteenth century, was almost common in the sixteenth. The small octavos and quartos were well in the majority. Even the folios were less unwieldy, and the enormous volumes of the past were almost unknown by the end of the first decade.

During this century it is remarkable to notice the enormous spread of the press as well as its activity just referred to. During the years 1501–1520 no less than twenty towns in Germany set up presses for the first time. In Italy, during the whole century, no less than 100 towns set up presses. In England the progress was not so apparent. Only twelve towns set up presses during the century, and most of these attempts expired before its close.

The struggle between the Roman and Gothic types was resumed early in the sixteenth century, and a third competitor entered the lists in the shape of Italic. It was cut for Aldus at Venice, it is said, from the designs of Francia and modelled upon the handwriting of Petrarch. Aldus obtained a privilege for ten years for the sole use of this type-face, and it was first used in the Virgil of 1501. The success of the Aldine Italic at once produced imitators. Forged editions were issued at Lyons, and printers elsewhere produced varieties of the type. As a result of the struggle between the Roman and the Gothic, the Roman began to gain ground in the Latin countries, while Gothic still remained supreme in those of Germanic origin. There began in 1509 that semi-scientific discussion of the proportions of print letters by Paccioli which was carried on by Dürer, Geoffroy Tory, and later by Moxon, which has lasted until our own day, and has produced such little real results. The real problem is to design a fount of type in such a way that whatever combination of letters is arranged no single letter will stand out from the rest. This test should be applied to any

type which is put forward as an artistic triumph. Whether to these investigations should be attributed the cutting of some excellent Roman types in France is uncertain, but it is sufficient to say that such types were cut and used for many years. Roman type was introduced into England in the early years of the sixteenth century and used first by Richard Pynson.

There were also cut, during the century, founts of Arabic, Syriac, Armenian, Ethiopic, Anglo-Saxon, Irish and music types. The only one of these which needs a word of explanation is the music type. In the fifteenth century music had been printed in two workings, the notes and stave at different impressions. The new type was of a different character. Each note was cast together with the piece of stave that belonged to it, so that the stave line appeared to a close observer to be broken into as many pieces as there were notes. This system was hardly ever used (if at all) for printing the Plain chant or liturgical music, for which the old method of two printings was retained.

One extraordinary variety of Gothic type may be specially mentioned. It occurs in "Theuerdank," an epic poem celebrating the Emperor Maximilian's wedding journey to Burgundy. It was probably composed in great part by Maximilian himself. Printed by Schönsperger, of Augsburg, it was published at Nuremberg in 1517. A special fount of type was cut for it by Jost Dienecker, of Antwerp, with enormous flourishes, especially to the letters "g" and "h"; for use when these letters occurred in the first or last line of the page. Many authorities believed the whole book to be cut on wood.

The use of coloured inks in the sixteenth century was very slight. It was confined almost entirely to red, used as in the previous century principally for service books. The various shades of brown and bistre were used by the chiaroscuro printers in Italy and Germany, but any real colour printing is almost unknown.

This century may be described as the golden age of the wood-cutter. In the first half, especially, numbers of great artists were producing work for book ornament and illustration. Basel, Nuremberg, Florence and Lyons are the four towns that stand out as producing some of the finest work. There is little doubt that soft metal blocks were also used, and these were produced in the same way as woodcuts.

Copperplate engraving and printing had been invented in the early part of the fifteenth century, but retained its special character, only a few books being illustrated in this manner. The use of engravings during the sixteenth century in connection with letterpress printing increased to some extent, but the woodcut retained its supremacy, and only towards the end of the century do we find any effective competition. The earliest copperplate work produced in England belongs to the period about 1540.

The printing press is supposed to have been improved about the middle of the sixteenth century by a printer named Danner of Nuremberg, who is said to have introduced a metal spindle in place of the wooden one used up to that time. It is true that some improvement must have been made to render the press more rigid, as we find the smaller type and more delicate woodcuts used at this time coming out quite sharp and clear.

In the technicalities of bookwork the printer advanced considerably during the period under discussion. The titlepage, which only appeared occasionally in the previous century, and then only in the label form (with one or two prominent exceptions), became an integral part of the book, and the colophon necessarily decreased in importance. Woodcut initials and borders were quite common.

The sixteenth century is not only noticeable for the great expansion of the press in Europe previously referred to. It was also the period when Asia and America received and practised the art. In India (at Goa) and in Japan the Jesuit missionaries introduced the printing press, and in Mexico an offshoot from the press of Cromberger in Seville was working before 1540.

The Seventeenth Century.

With the opening of the seventeenth century a period begins in which the art of printing continues the process of degeneration from its artistic beginnings, which was seen at the end of the previous century. It is a period of great happenings in political life, of revolutions long drawn out in England and France, and these inevitably left their impress upon the craft. The pamphlet, very little used in the fifteenth century, and only making a sporadic appearance in the sixteenth century, mostly, of course, in connection with the Lutheran controversy, became one of the normal methods of publicity, and the newspaper—the genuine periodical, not the mere paper of news—made its appearance. Old and damaged type was used, and the Dutch founders, who supplied a large portion of the demand for new type, had no type designers

worthy of the name in their employ. Here and there the old punches are rediscovered and founts of type cast from them, and books can be found which preserve some of the older traditions of beauty and proportion. The Royeroft Polyglot Bible is one of these books. The Roman type used in the preface is that used by John Day, the famous London printer of the sixteenth century. There is no new Roman type to which attention can be drawn during the period under discussion. To the types known before 1600 there were added Coptic and Samaritan. There was little change in the methods of printing music, although engraving was occasionally used. The number of Hebrew presses increased considerably, especially in Eastern Europe. The most important Hebrew fount cut in England was that for the London Polyglot in 1657, and this incurred considerable criticism. In Greek work this country has at least one production to be proud of in the Eton Chrysostom in eight volumes and in folio. This work, although the types were imported (or perhaps because they were imported), takes rank with the finest Greek printing. The type is similar to the Greek of the Stephanus press.

The best printing done in England during the seventeenth century was probably that in black letter. Acts of Parliament and proclamations were printed in this letter up to quite recent times, and the Old English or English Black, which had got quite away from the Fracturschrift of the Germans, and the Flamand of the Dutch, assumed characteristics of its own which rendered it quite a handsome letter.

Joseph Moxon attempted to draw up rules for the scientific design of Roman type, but they were unsuccessful, and, in fact, were more adapted to signboards than type. Moxon praised the Dutch letter, and probably imported a great deal. It may be said that there was no indigenous Roman in England during the century.

The reason for the want of enterprise in English typefounding was the restrictions imposed upon the trade. By the Star Chamber of 1637 the number of founders was limited to four, and a commission, consisting of the Archbishop of Canterbury or Bishop of London, with six others, was appointed to fill any vacancy. Free importation was the order of the day from 1640 to 1643, and from 1643 to 1662 the trade was free of restrictions. Owing to the Civil War this did not help it much, and in 1662 an Act reimposed the restrictions of the Star Chamber Decree of 1637 (cap. 27).

In France the characters cut during the previous century still held their own, and the Elzevier Bible, although printed in Holland, is a good specimen of the finest French work of the period. Towards the close of the century a new type was cut and used largely, which showed a degraded face from the fine models of the past, and formed a link between the early types and the modern effeminate French face.

Germany and Scandinavia were by this time the only countries to retain the use of the Gothic letter for ordinary printing.

There are no typefounders' specimen books known of the seventeenth century, although several founders issued specimen sheets. But several type specimen books were issued by printers, and the two best known are those of Fuhrman, of Nuremberg, in 1616, and of the Vatican press in 1628. Some copies of the latter are on grey paper.

The literature of the practical side of the art begins in the seventeenth century.

The English typefounder and printer, Moxon, was the first to issue a complete treatise on everything connected with the art. So good was it that at the end of the eighteenth century it was republished as an original and up-to-date treatise. Several books giving schemes of imposition were also issued.

A few words must be devoted to the earliest newspapers. The English *Mercurie* of 1588 has been proved to be a forgery, and the first English newspaper with a definite title has been identified as the *Weekly Newes* of 1622. Newspapers were issued earlier than this in Germany and Holland, the *Frankfurter Journal* and the *Nieuwe Tijdinge* of Antwerp being among the earliest. All newspapers of the Civil War period were in a small quarto, the foolscap folio size not becoming common until after the Restoration.

The press during the seventeenth century received a general overhauling and improvement at the hands of Blaeuw of Amsterdam. The exact improvements he made it is impossible to specify, as Moxon, who gives illustrations of both the new and old presses, only describes the new.

Finally, as regards the seventeenth century, it must be noted that printing was introduced into New England in 1640, and that in all countries which were comparatively free from the stricter press laws provincial presses became more and more numerous.

The Eighteenth Century.

We now come to the last 100 years of the period I am dealing with. In many respects it

is the most important, as although it did not see the great inventions which were to follow so soon, yet the development of the great industrial revolution was steadily forcing the craft towards its reorganisation as a machine industry. It will be difficult to do more than mention any of the movements on the Continent, as our attention must be concentrated on the English developments.

In 1702 the first London daily paper appeared —the *Daily Courant*. There had been a few daily numbers of the *Post Boy* in the 1680's, but the *Courant* was the first genuine daily paper. From that day the daily paper has been always with us. Whether the daily paper of 200 years ago had more news than that of to-day, or whether the censorship was working overtime then as now, it is difficult to say, but the limitations of the press at that time only gave the printer two foolscap folio pages to fill, and so there was not that wild desire for copy which characterises his descendant of to-day.

Turning to type, the Dutch typefounders were still in the ascendant, and Watson, the well-known Edinburgh printer, boasted in 1713 that all his type and ornaments were Dutch. An improvement was, however, on the way. William Caslon, the reviver of English typefounding, was born in 1692, and served his apprenticeship to an engraver of gun-barrels in London. When he started in business for himself he added the engraving of bookbinders' punches to his other trade. These were seen by the printer, John Bowyer, who introduced Caslon to James, the typefounder. After studying the art, Caslon set up in business as a typefounder about 1720. His first type specimen sheet was issued in 1734, and this contains the famous Caslon Roman types which form the model for all the standard book types of to-day. They were an instantaneous success, and until quite late in the eighteenth century were the leading style. They then dropped out of sight, and later we shall see how they came to the front again.

A great rival of Caslon was John Baskerville, of Birmingham, who was typefounder and printer, and who designed his own types and printed from them. His Romans were good, but somewhat more stilted than Caslon's, and his manner of printing and hot-pressing gave them a slimness of which all people did not approve. Baskerville's great triumph was his set of Italic capitals. These are beautiful in outline and effective in combination. His first book was the Virgil of 1757. Although Baskerville made a success artistically, his types never really became popular, and after his death they were sold *en bloc* to Beaumarchais for his printing office at Kehl. Their history after their use at Kehl is misty in the extreme, and only recently it has been rumoured that they have turned up in one of the largest provincial French printing houses.

The example of Baskerville led to imitators abroad, of whom the most famous was Bodoni, of Parma. His work retained the simplicity of Baskerville without the artistic touch of the English printer. Bodoni became printer to the Grand Duke of Parma, and his specimen book shows an endless series of Romans, Italics, Greeks, all on the most magnificent scale. His Greek Homer in folio is one of the most magnificent works ever produced. But all his magnificence does not seem to impress. His paper is too white, his ink is too black (if that be possible), and his type is too scientifically correct to please.

In Scotland the Foulis press produced some fine editions from type cast by Dr. Wilson.

When we turn to France we find all the greatness (typographically speaking) of the previous centuries departed. French Roman types had degenerated greatly. An attempt was made by Didot to follow the examples of Baskerville and Bodoni, but his attempt was poor in comparison, and French types resumed their downward course. This is not to say that there were not fine books and fine specimens of printing produced in France in the eighteenth century. There were, but there was no great revival such as took place elsewhere, and then in 1789 the Revolution diverted all printing to the pamphlet and the newspaper.

The eighteenth century did not see coloured inks used freely in connection with letterpress printing, but many processes were invented and used for producing coloured prints. For the detailed history of these I must refer to my paper read before the Society in February last.

Book illustration of the eighteenth century is very mixed. Copperplate, in conjunction with type, even on the same page, is common. Woodcuts were at their lowest ebb until Thomas Bewick revived the art by adopting the graver as his tool instead of the knife, and using the end of the grain instead of the plank. By this means he obtained a delicacy of line which enabled him to give a world of detail even in the smallest vignette. His work rescued wood and placed it in a position successfully to rival copper.

A word must be said as to the spread of the press. This may almost be said to be universal. In every part of the world, by the end of the eighteenth century, the press had penetrated. Even in England the provincial press began to bear some relation to the importance of the various localities. A feeble attempt on the part of the Government in 1793 to insist on the registration of all printers did not succeed, but before the end of the century it became tolerably common for the printer's name to appear on his work. For many years it had been the exception rather than the rule, perhaps because of the rigid press laws.

And now, as to the printing press itself. We have seen it as a simple screw-press used by the earliest printers, developing within a very few years into the wooden hand-press complete with rolling bed, tympan and frisket. We notice in the earliest pictures the inking balls of the pressmen. Now, at the close of the eighteenth century, 350 years after the first printer sent the first proof to press, we leave the press still wood, still with the slow motion that only allowed the quickest pressman to get 300 pulls in a working day, and still with the inking balls of the early days. To convey an idea of the method of the printer of this time I give a list of the operations necessary for making one impression:—

1. Inking the balls, or, as at present, the roller.
2. Inking the form.
3. Laying the sheet on the tympan.
4. Flying the frisket, and folding it and the tympan down on the form.
5. Running in the form under the platen.
6. Taking the impression by depressing the platen.
7. Running out the form.
8. Lifting the tympan and frisket.
9. Releasing the sheet and placing it on the bank.

It will always astonish those who examine this practical side of the history of printing that with such slow methods the great books, and still more the great newspapers, of the eighteenth century could ever have been produced.

LECTURE II.—Delivered November 30th, 1914.

The Early Nineteenth Century.

It is curious to reflect that in the year 1800, at least 350 years after the invention of printing, the art had developed so little mechanically that a fifteenth-century printer would have found himself quite at home in a printing office of the last year of the eighteenth century. He would have found the same wooden press, with perhaps some slight additions of metal screws and levers, which would be quite clear to his mind after one trial. He would see the same kind of inking balls used, and he would note that the paper, although of a quality not up to his standard for book printing, was produced in the same manner as in his own day. The type would perhaps appear to him better finished than that he recollected. But in all essentials the printing office of 1800 was the printing office of 300 years before. Everything we know to-day in the art has come into use since 1800.

The printed sheet of to-day is printed on machine-made paper. It is either set by a machine or set with machine-made type. It is either printed from this type or stereotyped by machinery. The press is a power press, and the resulting printed sheets are sewn, glued, and bound by machinery. My task now is to trace the development of the machine industry of to-day from the handicraft of the earlier period.

The three great inventions which made the present machine production possible were the paper-making machine, invented by the Brothers Fourdrinier in 1803; the printing machine, invented by Koenig in 1811; and photography, invented by Daguerre and Fox Talbot in 1839.*

Previous to these, however, an improvement which amounted to an invention had been made in the press by Charles, 3rd Earl Stanhope. The great change he introduced was to substitute iron for wood in the frame of the press, and add multiplying levers between the bar and the platen so that the work of the pressman was much reduced. William Morris was wont to say that this substitution of iron for wood was the only improvement that had been made in the art, and when we consider the enormous gain in rigidity we can understand what Morris meant. The power press did not exist for him, but he wanted the best possible effect from the hand press. The story of the hand press and its development after this date is an engineering one. Better castings, finer fitting, still more rigidity, and the proving press used to-day by photo-engravers produces those really wonderful proofs which their customers vainly try to emulate.

* The last date must be read in conjunction with the remarks on the history of photo-engraving in Lecture III.

Paper.

The paper-making machine invented in 1803 was in most of its essentials the paper-making machine of to-day. Up to this date all paper was made in single sheets by hand. The pulp was put into the mould by the workmen, and then the mould was shaken to distribute the pulp evenly, and the resulting sheet removed for drying and pressing. The principle of the invention was to substitute endless woven wire sheets for the mould, and as the paper was formed by the felting of the fibres to lead it between heated cylinders to dry and press it. As it came from the machine the paper was cut into sheets of the standard sizes. The continuous web of paper was being made in 1803, but it was not to be used as a web for rotary printing until 1868.

Printing Machinery.

The next great invention which attracts the notice of the student is the development of the printing press into a machine.

The three principles of printing machinery are, first, the platen action in which the pressure is applied by one flat surface acting on another. This was the hand-press method. Then follows the cylinder, round which the paper is led, rolling over the flat bed on which the type is placed. The third principle is the rotary method, where both type and paper are placed on cylinders geared together. Of the two latter the third was the the first to be invented, but the last to be used. William Nicholson, in 1790, took out a patent for a rotary printing machine which, however, was never made for

use. He also specified a flat bed cylinder machine similar in action as regards position of type and paper to the later invention of Koenig. But no really practical methods of using them were added to either of these inventions.

Before we come to the cylinder machines we must deal with the attempts to apply power to the hand press. Frederick Koenig in 1803, at Suhl, attempted this. He substituted leather rollers for the inking balls, and introduced mechanism to take the carriage under the inking rollers and then under the platen. Koenig came to London and succeeded in inducing Bensley, Woodfall and Taylor to finance him in his experiments. By 1810 he took out a patent, and in April 1811 he printed sig. H of the "Annual Register." This was a modification of Koenig's first attempt to apply power to the old form of press, and was patented by him in England in 1810.

The next year, 1811, he took out another patent, this time for the machine which was to be the parent of all flat bed cylinder machines from that day.

John Walter, of the *Times*, ordered two machines after seeing the new cylinder machine, and presumably after hearing Koenig's ideas for the future. The issue of the *Times* for November 29th, 1814, was printed entirely by steam power. Mr. John Walter's own account of the innovation is interesting :—

"Our journal of this day presents to the public the practical results of the greatest improvement connected with printing since the discovery of the art itself.

"The reader of this paragraph now holds in his hands one of the many thousand impressions of the *Times* newspaper which were taken off last night by a mechanical apparatus. A system of machinery, almost organic, has been devised and arranged, which, while it relieves the human frame from its most laborious efforts in printing, far exceeds all human powers in rapidity and despatch. That the magnitude of the invention may be justly appreciated by its efforts, we may inform the public that after the letters are placed by the compositors, and inclosed in what is called the 'forme,' little more remains for man to do than to attend upon and watch this unconscious agent in its operations. This machine is then merely supplied with paper, itself places the forme, inks it, adjusts the paper to the newly inked type, stamps the sheet, and gives it forth to the hands of the attendant, at the same time withdrawing the forme for a fresh coat of ink, which itself again distributes to the ensuing sheet, now advancing for impression; and the whole of these complicated acts is performed with such a velocity and simultaneousness of movement that no less than 1,100 are impressed in one hour."—The *Times*, November 29th, 1814.

I have said that some time after April, 1810, Koenig gave up entirely the idea of the modification of the screw press, and became a convert to the cylinder principle. It is alleged, with some background of justification, that Koenig borrowed the idea from Nicholson's patent of 1790. He certainly met Nicholson, who helped him to prepare his patents.

One other type of machine, constructed during the period ending 1814, remains to be mentioned. The printer of the *Norwich Mercury*, Mr. R. M. Bacon, together with Bryan Donkin, designed a machine in which the types were arranged and fixed on a revolving four-sided prism. The ink was applied by one roller, which rose and fell to meet the irregularities of the prism.

This patent, No. 3757 of 1813, contains the first reference to composition rollers, without which rapid machine printing would have been impracticable.

After Nicholson's, this was the first rotary machine as against the flat bed cylinder machines of Koenig.

It is difficult to say when Bacon and Donkin's machine was first used. The *European Magazine* for January, 1815, claims the invention for them as against Koenig, and goes on to state that another inventor had produced a printing machine at Plymouth "about ten years since, which has been and still is used by a tradesman there for printing his bills."

Koenig's final effort in this country was to transform his *Times* machine, which printed on one side only, into one that perfected the sheet or printed it on both sides during the progress of the paper through the machine.

His patent for this is dated 1814. One large machine of this sort was made for Bensley in 1815, but it was too heavy and expensive, and this was the only one made. It produced 750 perfected sheets per hour, or 1,500 impressions.

Koenig finally left England in 1817, and started the firm of Koenig and Bauer at Kloster Oberzell, where it still flourishes.

The invention was now accomplished, machine printing was a fact, and although the hand

press still held its own it must have felt the beginning of the severe competition.

We have followed the development of the flat bed cylinder machine for newspaper purposes to 1814. The machines then built by Koenig for the *Times* were used until 1827 (by 1824 they were printing 2,000 per hour), although Applegath and Cowper, who had succeeded Koenig at the *Times*, had modified them considerably.

In 1827 they built a new machine still printing on one side only, but raising the rate of impressions to between 4,000 and 5,000 per hour.

Perfecting had been abandoned. As Cowper says, "The principal object in a news machine is to obtain a great number of impressions from the same forme on one side of the sheet, and not from two formes on both sides as in books. This machine required eight attendants, four to lay on and four to take off. These machines were used by the *Times* until 1848, when the flat bed principle was finally abandoned.

The failure of Koenig's 1815 machine, for perfecting, was not the end of perfecters. Applegath and Cowper turned their attention to this type of machine and considerably improved it. With little alteration it developed into the perfecter of recent times.

Up to 1850 the job or book printer was content to use the hand press and the power platen machine, and the big houses used the perfecters mentioned above. Here and there, of course, various experimental cylinder machines were used.

The invention by Main in 1850 of his cylinder machine formed the first step in the sequence of Wharfedale type machines. His cylinder did not rotate fully, but after making three-quarters of a revolution reversed itself and at the same time was raised to clear the type carriage on its return journey. The bed also had a new drive, being a crank with multiplying gear attached.

In 1848 news and book printing machines parted company. Applegath in that year introduced once more the rotary principle. The failures of Nicholson in 1790, and Bacon and Donkin in 1813, were at last avenged, and rotary printing has been the method for printing newspapers ever since that date. He placed a great cylinder with its axis vertical, and with as many faces as there were columns to be printed. The type was held by wedge-shaped rules, and as many feeders were arranged round the machine as the space permitted. The next improvement was the Hoe machine, where the axis of the main cylinder was horizontal and the type held by a special device known as the Turtle. These Hoe machines in this form lasted until 1868, when the final great invention in newspaper printing was introduced and the Walter press was set up.

Printing Types.

Turning to the types of this early part of the nineteenth century, as Mr. Talbot Baines Reed said, Bodoni and Didot killed the old style and left the modern Roman. But the new Roman had hardly established itself when a demand for fat face type arose. All the founders supplied the demand, and the specimen books of this period are full of types with these broad faces. The usual reaction set in, and from an attempt to condense type after the French fashion arose the Scotch letter. The English founders, however, retained the rounder forms of letters. The period about 1820 was noted for good printing, but the Roman type used was not as legible as the old style. Hansard said, in 1825, "the specimen of a British letter-founder is a heterogeneous compound made up of fat faces and lean faces, wide set and close set, proportioned and disproportioned." This style was maintained with some slight improvement as regards book faces until the forties.

For this period one is always told to refer to the Chiswick Press for the best printing, and the books issued by Pickering are generally referred to. The work of Charles Whittingham the elder, the founder of the Chiswick Press, possesses few claims to distinction. It was his nephew who founded the press at Took's Court, and to whom his uncle left the Chiswick Press. He it was who printed books for Pickering which have always been looked upon as excellent work. Corrall, who printed most of the Diamond Classics for the same publisher, also did good work, and here it was, no doubt, the publisher who was responsible for the excellence of the volumes. Pickering was an artist in book production, and the simplicity and dignity of his publications had a great influence on the work of his time.

The combination of Pickering and the younger Whittingham produced most excellent results in later years; in fact, until the death of the former in 1854.

In 1844 Caslon's were asked to supply type for a Juvenal to be printed for Pickering in old-faced Roman. Caslon's discovered the old punches of the original Caslon's Roman type, from which a fount was cast. The Juvenal

not being ready, the type was used for Lady Willoughby's Diary, published by Messrs. Longman in 1844, and at once the old face type became popular, and began to oust the compressed and fat face varieties. Some people, however, considered it somewhat too archaic, and Messrs. Miller & Richard began cutting a series of revived old style faces. They were followed by the other founders, and from about 1850 the better class of book work has been in one or other of these types.

Engraving and Illustration.

I have now to deal with the methods of illustration and engraving.

Bewick's development of illustration on wood gave an impetus to the art which lasted until the rise of the photographic reproduction processes in the middle eighties. It did not preserve the high character which Bewick gave it, but gradually degenerated into a trade. There was a slight revival, artistically speaking, about 1835, but the effect of this soon passed. Artisans had taken the place of artists.

Woodcuts, of course, could be printed at the same time as the text, and the whole history of illustration during the nineteenth century is a search after a process which would mechanically produce from pictures or drawings blocks which could be printed in the same way.

The invention of photography in 1839 led to no immediate result in this direction, although Fox Talbot and others thought and experimented much on the subject. However, the early history of the development of photographic engraving is dealt with in the next lecture. The period under discussion does not contain any real commercial development in this direction.

Lithography had been invented by J. A. Senefelder in two forms: engraving on stone in 1796, and the chemical method or true lithography in 1798. It is unnecessary to go into the history of this art, as Mr. Pennell has so recently and so elaborately explained it to you. It was brought to England in 1800, and gradually attained popularity. Its use for book illustration was not very frequent, as it necessitated two printings on different machines; and it was, therefore, not a formidable rival to wood engraving.

Occasional books occur with illustrations printed by unknown processes, such as acrography, which was probably a method of surface printing etchings.

Colour printing during the first half of the nineteenth century was almost entirely of an experimental character. Always there was the attempt to get a colour process that could be printed in the ordinary press or machine. Savage developed wood-block colour printing to an extent hitherto unknown, but with no commercial results. Baxter, of course, was the great colour printer of the period, and his work was special to himself. His delicacy of treatment and wonderful eye for colour, together with a patience that must have been almost superhuman, places his work in a different category from any other. It was a personality, not a process.

This hurried survey of a period roughly corresponding to the first half of the nineteenth century leaves printing at a point when it had definitely developed from the handicraft of 1800 into the machine industry. With machine-made paper and machine printing, it only wanted one thing to complete it—mechanical illustration. By this time it was well on the way, and the principal topic of my next lecture will be this final development.

LECTURE III.—Delivered December 7th, 1914.

The Nineteenth Century (Part II.) and after.

The development of printing during the second half of the nineteenth century was rapid in the extreme, at least on the mechanical side. Machine succeeded machine, each more rapid and effective than the last. Processes of illustration were born and died, giving place to more rapid and accurate methods. Up to about the year 1890 it cannot be said that a similar advance took place as regards type and type design. If this period showed no development in the printed book, it at least was a period in which the book was produced in a solid manner. In the decent class of book the type was Revived Old Style or Caslon Old Face, the paper was a sound printing paper without any mixture of wood-pulp, china clay, or any of the other abominations of a later period, and the binding cloth was good and strong. The one-volume novel of the sixties or seventies will be found to-day in good order, showing signs of age perhaps, but wearing out, not falling to pieces, as our modern books do after about three people have handled them.

In the late eighties there was a curious epidemic among printers of the use of colour in letterpress work. This was, of course, mostly in job work, but it spread to book work, and there are monstrosities to be found in the way of decorated titlepages in many colours which are calculated to make anyone interested in good printing feel very ill. This curious movement was known, for some obscure reason, as Art Printing. These printers liked to use tint blocks and scroll work and ornamented initials and borders, and all without any idea of the real value or balance of the printed page. The "artist printer" of this period was the man who got most eccentric designs and colours on to the sheet of paper. Luckily for us all, a change was caused by the foundation of the Kelmscott Press by Mr. William Morris. The influence of this Press cannot be overestimated. Morris restored handmade paper, black ink, and good press work to a position that they had lost for many years. The archaic character of his types, which one must admit was carried almost to excess, was one of the most important factors in this revolution. The buyers of modern books, many of whom perhaps had never seen a fifteenth century book, were simply taken off their feet by the magnificence of the Kelmscott Press books. We, of course, know them so well that we take them for granted; but imagine the collector of the editions de luxe of the 1890 period, with their thin type and almost finicking get-up, seeing the "Golden Legend" for the first time. Morris set a fashion of good printing, and even of plain printing, because although the Kelmscott Press books are decorated, they are decorated, as it were, in addition to the printed page. I do not think there is much doubt that Morris would have preferred to illuminate every copy himself, but this being impossible he allowed his designs to be printed at the same time as the letterpress. Morris's designs were personal to himself, and it is perhaps as well that all the ornaments of the Kelmscott Press were withdrawn from use on his death. The type can be used according to his rules, and has been so used with effective results. The types of the Kelmscott Press were three in number. The Golden type, a Roman based on Jensen's letter but with a slight admixture of Gothic style; the Troy type, a round Gothic; and the Chaucer, a smaller Gothic. The Golden type has been copied and modified by many typefounders, and, of course, often spoiled in appearance. The Gothics have not had so much attention paid to them.

The Doves Press was founded by Mr. Emery Walker and Mr. Cobden Sanderson. The type cut for them was a very plain and handsome Roman with a thinner face than that of the Kelmscott Golden type. The style of the Doves Press is one of great restraint. Ornament is unknown, and only here and there is found an initial in red of a striking and effective character.

The type used by Mr. St. John Hornby at his Ashendene Press is based on the Subiaco type of Sweynheym and Pannartz, and is therefore to be described as a semi-Roman. It is effective, and the great Dante of the Ashendene Press is worthy to rank with the Kelmscott Chaucer and the Doves Bible. These three books may be described as the ideal books of modern typography.

The type specially designed by Mr. C. R. Ashbee, for use at the Essex House Press, in printing the King Edward VII. Prayer Book, will be noticed as distinctly different from the other types mentioned, and it certainly is not so successful. The letters contain too much added ornament. Sufficient reliance is not placed upon plain lettering.

These Presses, to which must be added the Vale Press with a very excellent Roman fount designed by Mr. Ricketts, had a great effect on printing. They created a demand for sound Roman type, and although the printer was only slowly educated up to supplying the demand, and occasionally would make such "bloomers" as to print Caslon Old Face on an art paper, still progress was visible. At times, in fact, the artistic movement went too far. A few years ago there was a passion for posters printed entirely in capitals. This had probably been induced by a study of inscriptions and of the Aldine Poliphilus of 1499. The result was our leading educational authority issued a series of posters containing perhaps forty or fifty lines of solid caps. They looked very nice, but were almost unreadable. Nothing is more dangerous than carrying a cult too far and forcing a process or method to do what it is not adapted for. A face of type may be good for an inscription of four or five lines and impossible in a page of fifty or sixty. All this simply means that theory and practice must work together, and only when they are in strict harmony will the result be really effective.

Typefounders' specimen books of to-day show a great advance from those of the early nineties of the last century. Even in America, where the jobbing types are often of the most eccentric character, the book types were quick to catch the note of the English revival. Morris's types were copied immediately, and in one form or another the new (and old) Romans are to be found throughout the better-class printing of the United States. Germany, of course, followed quickly. Not content with their modified Fracturschrift and the large number of Romans already at their disposal, every typefounder in Germany set out to design and cut new forms of letter. It is practically impossible for type designers to make a decent living in this country, but in Germany it is almost a profession. Goebel's great volumes issued every few years show the progress of the art in every department in Germany, and in no section is progress so marked as in that of type design.

Then, again, another great effect of the revival was to draw attention to the correct placing of the type on the page, and to the fact that the opening of two pages of a book is the unit and not the single page. These matters are much better looked after now than they were, and English books have a much better appearance in consequence.

To-day, except for a slight want of originality in type faces, British book printing can bear comparison with that of any country. For book work this country has been almost without a rival for two hundred years. Apart entirely from the private presses I have mentioned, great commercial houses, such as the Chiswick Press, have carried on the tradition of good, solid and artistic work.

There is unfortunately another and a larger section of the printing trade which cannot be said to hold its own in comparison with the work of other countries, and that is ordinary job printing. Prospectuses, advertisements, and other work requiring artistic design and a knowledge of the circumstances of the publication and the resources of the printing office, do not compare favourably with similar work issued in many other countries. A correspondent in Vienna used to send me every year a parcel of ordinary job printing of this kind—good, bad, and indifferent. On looking over the items it was seen that the good prevailed. Similar collections made here do not show the same result. This may be due to the different conditions attaching to technical education. Here, more attention is paid to rapid production and to the teaching of the mechanical art. If artistic training in typographical design is to be had, it is very often divorced from the rest of the course. I would suggest that this is not so in other countries, and that the tremendously rapid advance in artistic typography seen in Germany during the last twenty or thirty years is due to the fact that they have found some method of bringing together theory and practice—of harmonising artistic design with the mechanical trade.

The greatest change in printing is the introduction of typesetting machines. This was one of the great ideals of inventors, and from about 1840 a continuous succession of inventions made their appearance. Generally their exit followed very quickly. The *Family Herald*, a well-known journal to-day, made its first appearance in 1842 in ordinary newspaper folio form with the picture of the composing machine by which it was set up in the head-line. The *Times*

was set up by the Kastenbein machine for many years, latterly with new type daily made by the Wicks Rotary Type Caster. The Thorne machine was a considerable success in the eighties. These machines all took type as it came from the founder. The type was arranged in funnels and fell into place when a key was struck. They generally had a subordinate machine called a distributor to arrange the type in proper order. The invention of the Linotype in 1884–85 brought a new principle into play. Instead of using type, the pressure of a key brings down a matrice of that letter. A line of these matrices automatically justified is carried to the front of the metal pot, where a line of type is cast in solid form from it. During this time the operator is assembling the next line of matrices. When the operation of casting is complete, the slug is automatically shot into a tray and the matrices are taken up by an arm to the back of the machine and hung on a bar. As they are pushed along this bar they fall automatically into their right boxes, and are ready to be used again when required. The solid lines of type or slugs are arranged in a galley, and after correction are ready to be printed from. Most newspapers are set up in this way to-day. After stereos have been made from them the slugs can go back to the metal pot and be used over again.

The Lanston Monotype is on a different principle. It is a type-casting machine casting separate types and actuated by a perforated roll of paper on the Jacquard principle. The keyboard is used for perforating the paper, and the operator at the keyboard has nothing to do with the caster, which may be in another room or another country. In fact, the perforated paper can be sent to America instead of sending stereos, and can be put on a caster there, and the type will be produced in exactly the same manner as if it had gone straight to the caster here. Both machines are actuated by compressed air, and the action of the paper on the caster can be compared to the same kind of perforated paper used on a pianola. The matrix used is a plate of steel about 4 ins. square. On this is found the full alphabet, together with the various sorts necessary. It is actuated by a very wonderful series of levers, which enable it to take position so that any letter or figure may be cast. The work is very rapid, and corrections can be made by substituting single types, whereas in the Linotype the complete line has to be recast. The *Times* is set by Monotype machines, and a great deal of book work is done on them. A new attachment to the keyboard enables the operator to set two editions of a book at the same time, say a 6*s.* novel and the same book in 7*d.* form. The 6*s.* edition can then be set up by the caster and when the time comes for the 7*d.* edition the other roll of paper can be at once put in hand without any further work on the keyboard.

These two machines have revolutionised printing. All our newspapers and cheap books are produced in this manner. For display work and important books, however, hand-setting still holds its own, and although it is dangerous to prophesy, especially in an industry like printing with its rapidity of change, I cannot help thinking (and hoping) that it will continue to be supreme.

Photographic Illustration.

I now turn to the second division of my subject, the development of the processes of illustration.

Although what we know to-day as photography, namely, the production of pictures by the agency of light, was brought to a successful issue by 1839, the action of light on a sensitised surface was known long before. Experiments had been made by Wedgwood in England, but he failed to fix the images he produced. Niépce in France was the first to produce a permanent photographic image. He coated metal plates with a varnish of bitumen dissolved in oil of lavender, and when dry he exposed them to the camera, afterwards developing the image by the solvent in which the bitumen had been dissolved, so that he obtained plates with the design in bare metal on a varnish ground. He also exposed his plates under fine engravings, and these plates he etched, so that he was able to print from them in a copperplate press. The earliest known example of his work is a portrait of the Cardinal d'Amboise, said to have been printed in 1824. Niépce's process was perfected by his nephew Niépce de St. Victor. The bitumen process first used by Niépce was afterwards developed and extensively used for the production of printing surfaces in intaglio and relief. The next important discovery was that the combination of gelatine and bichromate of potash after exposure to light became more or less insoluble, and therefore impermeable to an etching solution such as perchloride of iron. So by coating a plate of steel or copper with a film of these materials and exposing it to light through a photographic negative, it became possible to etch the plate in proportion

to its exposure. This is Fox Talbot's method of photographic engraving of 1852 and 1858, and also forms the basis of modern photogravure introduced by Karl Klic in 1879. This type of film is also unabsorbent of water in proportion to the action of light, and if placed in cold water after exposure will swell up unevenly and form a relief or mould from which casts can be made in plaster or by electrotyping. This forms the basis of Pretsch's process in 1854, and generally of photo-galvanography or photo-electrotypy. Again, the same type of film exposed to light under a negative, then moistened with water like a lithographic stone, and inked with a roller and printing ink, will only take up the ink in the exposed parts in proportion as the action of light has rendered the film unabsorbent of water. This is Poitevin's process of direct photo-lithography (1855). If the exposed film be inked up without wetting and then placed in warm water, all the unexposed gelatine will dissolve, leaving ink only on the image, which may be transferred to stone or printed from direct, in which latter case it corresponds with Tessié de Mothay's photocollotype (1865).

Parallel with these efforts for the reproduction of tones, there were similar efforts for the reproduction of line work, and, following the discovery of photo-lithography, these were at last successful.

It was discovered by Gillot in 1872 that Fox Talbot's old method of making intaglio plates could be utilised for making relief blocks. The following description will be seen to be almost the same as the earlier method.

A zinc or copper plate sensitised with albumen and potassium bichromate is placed in a printing frame with the negative, and the picture obtained by exposure to light. The plate is then inked and washed, the surplus ink comes away, and the picture remains visible. Asphaltum is then dusted on to the plate, which is then etched to a sufficient depth to give a printing surface. This is one of many methods which differ only in the chemicals used and the elaborations introduced for special work.

Many processes were in use by the seventies and early eighties, but none of them really reproduced all the tones of a picture from the high lights to the deep shadows, and at the same time produced a block which could be printed with letterpress and by the ordinary machine. What was wanted was some method of breaking up the tones of a photograph into lines and dots so that a relief block could be made from it. The early experimenters used screens of crape and similar fabrics, but without much success. Somewhere in the early eighties glass-ruled screens were introduced, which were turned round during the exposure; and finally Mr. F. E. Ives, in the winter of 1885–86, sealed two single-line screens together and made the cross-line screen which is used to-day. This screen varies from 50 lines to 400 lines to the inch. This made the half-tone process possible. The only difference between the actual preparation of the half-tone plate and the line plate previously described is that the negative for the half-tone is taken through the cross-line screen, thereby breaking up the picture into a series of dots.

The latest development of photo-engraving has been in the direction of mechanically printed photogravure. This process, based on Talbot's and Klic's discoveries, is an intaglio method and not relief. A print is made through a screen of transparent thin lines and crossing each other on photogravure carbon tissue. This tissue is laid down on a copper plate for flat printing, or a copper cylinder for rotary work. It is then developed and etched. The lines of the screen being so fine are just sufficient to hold the ink on the cylinder; but when printed the ink runs slightly, with the result that in the deep tones the screen lines are invisible. By the most recent developments it is possible to print, not only the pictures in a magazine or newspaper, but the letterpress as well. This is set up and photographed at the same time as the pictures. It is generally possible in the inscriptions under the prints to see the lines of the screen.

Other Methods of Illustration.

Revival of wood-engraving took place in the sixties; but although great artists drew for the wood and on the wood, the wood-engraver himself did not rise to the occasion, and it was a period of great illustration not always successfully carried out. I will quote what Mr. Gleeson White says in his important work on this period:—

"Soon after this revival wood-engraving as a trade began to feel the photographic competition. By the time the half-tone process was established it was dying, and it was very soon quite dead."

Lithography, on the other hand, has acquired additional strength during the photographic period. The most adaptable of reproductive methods itself, it has adapted photography. As printing machinery developed so lithography

developed, and from the hand-press method of the early nineteenth century we see it using the power press in the early fifties, adopting the new metal aluminium as soon as it was cheap enough, and then using great sheets of it in a rotary machine for printing posters and other large work. Finally, an accident led to the invention of the offset method of printing, which enables lithographs to be printed on any surface of paper. The offset press has a rubber cylinder introduced between the stone or aluminium sheet and the impression cylinder; so that, instead of the hard surface of the stone or plate coming in contact with the paper, the yielding surface of the rubber takes up the design and transfers it to the paper. A much softer impression is obtained with good results. Like all new processes, it was set at once to do work which it was not adapted for, with disastrous results; but as printers have got to know the limits as well as the possibilities of the method, they have succeeded in obtaining better and better results.

Printing Machines.

The third section of this lecture deals with the development in printing machinery from about the middle of the nineteenth century. We have still to deal with the three classes of machines—the platen, the flat-bed cylinder, and the rotary. Although it is not strictly correct chronologically, I propose to take them in that order. The hand press it is unnecessary to deal with, as its history was finished in my last lecture. But the platen machine is a development from the hand press. The platen and the bed are still there, but no longer horizontal, but vertical. The original inventor of this machine was an American, Geo. P. Gordon. The bed is fixed and the platen is forced up to it by steel arms on either side. The platen then returns to its open position, and remains so long enough for the operator to take the printed sheet out with his left hand and lay on another with his right. This press in its various forms is pre-eminently the small jobbing press, although the heavier presses are used considerably for colour work.

The flat-bed cylinder machine began its period of great success soon after 1850. The Main machine, previously referred to, is dated about 1850, and from that time progress has been continuous. Koenig's continuously revolving cylinder of his 1811 machine is now found in the drum-cylinder machines, principally used in America.

The single-revolution or Wharfedale machine, in which the cylinder stops after each revolution to allow of the backward traverse of the bed, came into use about 1860, and has been much improved since then. In the two-revolution machine, of which the Miehle is a type, the cylinder makes two revolutions to each to-and-fro motion of the bed, but during the reverse movement of the bed the cylinder is lifted clear of the type. The two-colour machine enables two colours to be printed on the one sheet before it leaves the press. There are two formes, one at each end of the bed.

The final section of flat-bed cylinder machines is that of Perfecters. These machines print single sheets on both sides during their traverse from the feed-board to the delivery-board. They have two large cylinders instead of one. This type of machine is gradually dying out, being attacked by the fast Wharfedale machine on the one hand and by the rotaries on the other. Of late years the addition of automatic paper-feeders, mostly pneumatic in action, has quickened up the action of printing machines using flat sheets.

Turning to Rotary machines, I carried their history up to the introduction of the Walter machine into the *Times* office in 1868. This was the first machine to print on the roll of paper, from curved stereos, to perfect the sheet and produce a complete newspaper. These machines were used by the *Times* until 1895. Folding mechanism had been attached to them about 1885.

The development of the newspaper machine during the twenty years following the introduction of the Walter Press was slow. Single-roll machines were the rule rather than the exception, and the increasing circulation was met by putting in fresh machines. The newspapers during the period 1870–90 were only four to eight pages, and this was the limit of the machines then used. The competition, however, added to the cheapness of paper, resulted in an enlargement to twelve pages. Such enlarged issues could not be printed on one machine. The extra pages had to be added by hand. This resulted in the construction of machines that would produce newspapers of a varying number of pages, from four to twelve or sixteen, all inset, cut at the head, and folded in a more convenient form. It was found to be impracticable to produce these different sizes from a single web of paper; therefore several printing presses* were

* In England the distinction between the words press and machine is definite. Press is only applied to the hand press and the platen. All others are machines. In America the word press is applied to all. I have been somewhat indiscriminate in my use of the words, inclining more perhaps to the American than to the English use.

combined in one machine, each printing from a separate roll or web of paper and all conveying the printed sheets to the same folder, where they were incorporated in the one newspaper. Such is the multiple web machine of to-day. A classification of these combined machines may be made as follows :—

1. Two presses at right angles to one another and forming one machine. These are known as supplement or quadruple presses.

2. Two or more presses working one above the other with connection between each. These are known as two-decker and three-decker machines.

3. Two or more presses one behind another and capable of being coupled together to form a combined machine. This is called the tandem system.

4. Two presses arranged with a space between them where the folding mechanism is placed.

It may be said that there is no standard pattern of newspaper printing machines. The conditions in each office vary so greatly as regards space, both in area and shape, that each case is treated on its merits and special designs are made.

We now resume the history of the newspaper printing machine where we left it at the introduction of the Walter Press into the *Times* office in 1868. The Marinoni machine was introduced in Paris in 1868 for the purpose of coping with the increasing circulation of *Le Petit Journal*. This was not a web printing machine, but was the last and most rapid of the sheet-fed newspaper machines. Two of the machines were bought for the *Echo*, and that paper was printed by them early in 1872. About 1874 Mr. Edward Lloyd introduced the first open-delivery Hoe machine, which printed from the web. Hoe rotaries had been used for some time previous to this date in America. The Hoe Double Supplement Press was introduced about 1887, and eight machines were installed to print *Lloyd's Weekly Newspaper*. This machine turned out four, six, eight, ten, and twelve-page papers at 24,000 per hour, and sixteen-page papers at 12,000 per hour, the odd pages being in every case accurately inserted and pasted in, and the papers cut at the top and delivered folded. This machine is of the right-angled variety mentioned above, and prints from two rolls, the one on the long side being twice the width of the other, which is only one page wide. In 1895 these were superseded by Hoe's three-roll presses, using single-width webs. These machines had three reels of paper at one end, and the supplement press at right angles was rendered unnecessary.

In the same year, 1895, the *Times* replaced the Walter presses by Hoe's three-roll machines.

Lloyd's three-roll single machines were replaced in 1901 by the three double-width roll or sextuple type. These produced double the output of the single machines and necessitated the use of two folders instead of one. In 1902 the order was given by Messrs. Lloyd to Messrs. Hoe for the first of the present battery of seven double octuple machines. These machines, which now print *Lloyd's Weekly Newspaper*, are the most powerful newspaper printing machines at work in this country at the present moment. They take four double-width reels of paper at each end, are four decks high, and are constructed in such a manner that another deck still can, if necessary, be added at the top. The capacity of each of these machines is 144,000 per hour, up to sixteen pages ; from eighteen to thirty-two pages, 72,000 per hour, and so on in proportion. The papers are delivered folded and automatically counted.

The latest improvement in newspaper printing machinery is the making of the stereotype plates by machinery. After the flong—that is, the paper matrix—has been made by pressing it on to the type, it is placed in the casting-box of the autoplate, and as many plates as are necessary are cast from it. They are trimmed automatically and are ready to go on to the press.

Rotary machines are also used for the big runs of popular journals, and if the journal has a coloured cover this is printed on a smaller rotary at right angles. The body of the paper and the cover are brought together at the folding mechanism, and the complete paper stitched in its cover is counted out in quires.

So we have seen in the last hundred years the development of the art we saw emerge from obscurity some 450 years ago. All the speed and wonderful power of production we have seen it gather is unfortunately not all gain. Worse printing can be and is done to-day than ever has been done ; but at the same time there appears to be some light in the darkness, some indication that the printer is taking more interest in his craft and is beginning to realise more of its possibilities. The good effects of the work of William Morris and Emery Walker are distinctly visible, and there is hope for the artistic future of the "Art preservative of all Arts."

LECTURE IV.—Delivered December 14th, 1914.

The recent history of colour printing is divided easily into two sections—non-photographic and photographic. Each section comprises three methods — intaglio, relief, and planographic, so that the subject is comprised in these main headings :—

Non-Photographic.

Intaglio.—Etchings and copperplate prints of all kinds, in colour.

Relief.—Chromo-Xylography.

Planographic.—Chromo-Lithography.

Photographic.

Intaglio.—Photogravure.

Relief.—Half-tone.

Planographic.—Photo-Chromo-Lithography, Chromo-Collotype.

Doubtful and combination processes, of course, add to the number.

Chromo-Lithography.

The period I am dealing with in this lecture begins with the rise of chromo-lithography.

By 1850 the problem of the super-imposition of colours had been solved, and the art started on its triumphal course. In 1856–57 Lemercier, of Paris, printed an edition of the "Imitatio Christi" for which illuminated borders were copied from early manuscripts, and every page was decorated. In England, Owen Jones was working on his "Grammar of Ornament." It was printed by Day & Son, who were at this time the leading chromo-lithographers in London.

The most important non-commercial application of chromo-lithography was begun in 1856 by the Arundel Society, which issued prints of Italian frescoes until quite recent years. They were not all printed in England, some well-known German firms producing many of the later prints.

The "oleograph," a rather distressing form of the chromo-lithograph, was of German origin The finished print was thickly coated with varnish and then passed between patterned rollers giving the impression of canvas.

In the early days of chromo-litho work, the prints were frequently produced on thin paper. After printing, the margins were cut off and the print mounted on thicker paper, or, in the case of book illustration, mounted on the pages left for them. In several cases of books in the early fifties, spaces were left for illustrations to be mounted on the same pages as the text.

The method of chromo-lithography is shown very well in Audsley's book on the subject. The object—say, a water-colour drawing—is dissected by the litho artist into the number of separate tints required for its reproduction. A key plate in black is produced, and as many pulls taken as the number of printings required. The part of the design to be printed in each colour or tint is then transferred to a separate stone. The series of progressive proofs in Audsley's book shows how a picture is built up by the successive printings.

The history of chromo-lithography during the last sixty years (except in its association with one or other of the photographic processes, which is dealt with later) is a history of technical improvements rather than of revolutionary change. Better work can be done and is done to-day than at any previous period, owing to these improvements in ink, paper, and machines. Photography has, no doubt, closed many doors to chromo-litho work, but there are many fields in which it retains its supremacy. Artists have turned their attention to it in recent years, and many auto-chromo-lithos have been produced. The style found to harmonise best with the process is curiously similar to the plates in the first book printed by Hullmandel by his chromo-lithographic method. It is possible that there are greater artistic developments ahead for this method of work.

The offset machine which I described in the third lecture has been adapted for colour work. Here its ability to print on any surface paper is of exceptional value, and the softness of the colouring of some offset productions is very effective.

Copperplate Printing in Colours.

Intaglio plates—that is, mezzotints, stipples, and line engravings—are printed in colours to-day in exactly the same way as in the eighteenth

century. The plate is inked by hand with all the colours necessary—practically painted—and the whole printed at one impression. The modern development described as colour etching has various exponents. By some the plate is printed twice, first for the broad masses of colour, and secondly for the actual lines of the etching. The specimens shown by Hugh Paton and V. Preisler sufficiently indicate the scope and method of this process.

Wood-block Colour Printing.

In relief printing the most interesting process after 1850 is wood-block colour printing. This process, where separate blocks are used for each colour, gives an impression of transparency which cannot be obtained by any other.

This method of colour work was carried to a considerable pitch of excellence by Savage about 1820, and it was probably after seeing his work that Thomas Bewick suggested the printing of pictures in colours by means of wood-blocks. It was not, however, until about 1850 that wood-block printing became at all common.

The two most effective English workers in chromo-xylography were Edmund Evans and Benjamin Fawcett. The latter is a striking instance of unaided genius working alone and producing effective work. His illustrations to Morris's "British Birds" will alone suffice to keep his name in the annals of great colour printers. The book illustrations of Edmund Evans are, perhaps, the best examples of pure wood-block colour work carried out in this country.

The most typical works of Evans in later years have been the books of Walter Crane, Kate Greenaway, and Randolph Caldecott, specimens of whose works are on show, together with some earlier productions for the purpose of comparison.

Chromo-xylography is not prominent in the colour work of the Continental printers. But there is one exception. The firm of Knöfler, of Vienna, founded about 1856, has produced work of the highest character by this process. Religious prints of all kinds have been their speciality, and the transparency of the colours and the general beauty of their work give the firm a very high place among colour printers.

Miscellaneous Methods.

There are a few processes of colour printing which do not quite come under any of the headings I have adopted, and these I propose to take, perhaps out of their order, so that the latter part of my lecture can be devoted to the photographic processes. An important machine in this class is the Orloff. This is the invention of a Russian engineer, and is used in the State Printing Office at Petrograd for printing bank notes and similar colour work. The method of printing is quite different from any other. On a large cylinder are fastened the various printing blocks, one for each colour. A series of inking devices apply the correct colour to each block as the cylinder revolves. These blocks transfer their colours to composition rollers, which in turn apply it to the "form" block. All the colours are by this means superimposed on this form block, which then comes in contact with the paper and deposits the whole of the colours at one impression. It might be imagined that this process of superimposition of wet colours would cause smudging or blurring, but work produced by the Orloff press is noticeable for clearness of outline and delicacy of detail. The machine has been put on the English market once or twice, but has never been adopted.

Another recent process of interest is stencilling by machine. This method has been considerably used for roughly colouring plates. It has now been made possible to stencil by machine, Orsoni's Aquatype having been invented in 1898 and since perfected. The sheets or prints to be coloured are fed on to a travelling band, which carries them in turn under as many stencils as there are colours to be applied, when another portion of the mechanism passes a colour brush over the stencil then in position on the sheet. Some of the French fashion papers have their plates tinted by this machine, which is also extensively used for picture postcards.

Photographic Processes.

The whole of the photographic colour processes may be divided into two series. The first includes all those in which the photograph is merely the basic plate or outline, and the colours are selected by eye and printed over it. Postcards, for instance, are frequently printed with a collotype basis and lithographic colouring. As far back as 1858 Geo. Baxter patented a method of colouring photographic prints lithographically. These combinations are too numerous to mention.

Photogravure.

Photogravure plates are frequently printed from in colour by the old eighteenth-century method of inking the plate with all the colours and printing at one impression. The facsimiles

of the paintings of G. F. Watts have been produced by Messrs. Emery Walker in this manner. Before leaving photogravure it must be mentioned that constant attempts have been made to print photogravures in colour by machine. This process has been adapted to fast rotary printing in monochrome, and flat-bed machine photogravure is common; but with the exception of a few experiments, machine-printed photogravure in colours belongs to the history of the future, and is therefore outside the scope of this paper.

There is, however, one process which has not yet been made public that I may refer to. This is a combination of the intaglio and offset methods, and the experimental prints have been made by Mr. Geo. W. Jones. The machine is called the Renaissance, and is made by Linotype & Machinery, Ltd. Instead of a copper cylinder, as in the ordinary photogravure machines, a strip or sheet of copper is used, and the picture etched on the flat sheet, which is then bent round the cylinder. The wiping is done with rollers instead of the ordinary steel knife, and the impression is taken on a rubber cylinder, which transfers it to the paper. The first experiment made in colour on this machine was a reversed half-tone three-colour, but later photogravure negatives have been used with very effective results. A high-grade softness of colour is produced, and the high lights are better cleaned than with the pure photogravure method. It will be very interesting to see the later work of this machine. The colour prints by the Rembrandt Intaglio Engraving Co. in two and three printings are by a secret photogravure process.

Three-colour Process.

I now have to deal with the three-colour process, and describe how the automatic selection of colour was invented and developed. The idea of three-colour printing was not new, having been used by Le Blon in the eighteenth century. His ideas were based on the investigations of Sir Isaac Newton. Further researches in the early part of the nineteenth century by Dr. Thomas Young led him to put forward the theory of three primary colour sensations; but until Helmholtz revived it in 1853 it had been shelved. In 1860 Clerk Maxwell made a complete study of the subject, with the result that in 1861 he was able to take three photographs of a piece of coloured ribbon through three coloured light filters. By superimposing the three images obtained, and projecting them in an optical lantern through the three filters, he obtained a coloured image of the ribbon. This image was not perfect, owing to the fact that photographic plates were not at that time sensitive to red and green. It was suggested, very shortly after, to apply the principle to colour printing, but the photographic plate difficulty was not removed until 1873, and then only partially, while the complete discovery of the principle of colour sensitive plates did not come about until the early eighties. Dr. E. Vogel in Germany, and Mr. F. E. Ives in America, were proceeding on very similar lines. Mr. Ives had already invented the cross-line screen, and it is owing to his researches that the three-colour block process became possible.

He exhibited at the Philadelphia Exhibition of 1885 prints made by this process, but thought so little of it that he did not trouble to patent it. At that time the colour filters and the half-tone screens were comparatively imperfect, and commercial work was still some distance off. Not until 1891 was any commercial work put forward, and in the latter part of this year several English firms took the process up. One of the first three-colour prints produced in this country was a plate representing the famous racehorse that won the Derby in 1890. This was produced by Messrs. Waterlow & Son in February, 1892, as a supplement to the paper *Land and Water*. The improvements in the process that have taken place since that time are purely technical, the character of the process remaining the same.

The technical description of the process which follows is taken from Gen. Waterhouse's introduction to the catalogue of the photo-engraving exhibition at South Kensington :—

"The problem to be solved in photographic three-colour printing is a complicated one, because the light reflected from the objects to be reproduced must first be analysed and divided into its three components, red, green, and blue-violet, by means of carefully selected coloured screens or filters, so that each of them may impress a negative image, or colour-record, upon three suitably sensitised photographic plates of the parts of the object containing it, the densities of the three images being proportionate to the quantity of each light passing through the screens and its luminosity. These three images must correspond exactly in size, so that they may register correctly.

"From these three colour-sensation negatives, positive prints are made suitable for the process selected, whether by superposition of transparent

films, collotype or block printing, and must be printed in three colours or pigments, complementary to the filters used, viz., cyan-blue for the red sensation negative, crimson for the green, and yellow for the blue-violet.

"The correct combination of these three should reproduce the colours of the original. Owing to the difficulty of obtaining suitable permanent pigments to meet the theoretical requirements in three-colour block printing, some workers add a fourth block printed in grey or black, to give strength and harmonise the colours. The greatest care has to be taken throughout in the proper selection and adjustment of filters, photographic plates and printing colours. The least divergence throws out the balance and produces a false effect.

"Practically it means the mutual adjustment of at least three different sets of three variable factors with almost mathematical accuracy. The printing processes are still imperfect, but the discovery of new sensitisers for the photographic plates, and fuller researches into theory and practice, are bringing about constant improvements, and it seems likely that before long their use will be greatly extended."

The method of photographic colour selection can be and is applied to the other photographic processes, but not yet to anything like the same extent as to the half-tone process.

The improvement in printing due to the introduction of more perfect machinery has had a considerable influence on the three-colour process. The two-revolution type of machine, such as the Miehle or Century, was found to give better register and possess more inking power, which has helped the process. Then, too, the platen press has of late years improved in strength of impression and inking power, which has enabled it to be used for colour work. The question of the ink is a serious one. It has improved in quality and in accuracy of tint, but the permanency of the colours still leaves much to be desired.

Several machines for simultaneous printing of colours have been invented. With the exception of the Orloff already mentioned, none appear to have survived. The Miehle machine has been adapted for continuous colour printing by joining three machines together by means of a special delivery apparatus, so that when the sheet leaves one machine it passes to the next, and so to the third.

The four-colour process is described in the following extract from Mr. W. Gamble's article on "Modern Colour Processes":—

"Whether to use three or four colours has long been one of the contested points in colour work. The theoretical advocates of three colours have stoutly held out for three-colour; but many practical men hold the faith that three colours can never give an entirely satisfactory rendering of the subject. The weakness of the three-colour process is chiefly found in the rendering of blue in all its gradations, in its inability to yield a good grey, and in the imperfection of the blacks, which, according to theory, should be formed by the superposing of the three colours in equal strength. The remedy proposed is to use a black or neutral grey as a fourth printing. Dr. Albert advocated this in his citochrome process, and many leading Continental workers have followed him. In America a firm known as the Quadricolour Company make it a rule to use four colours, and do admirable work. It is, indeed, quite general in America to find four-colour being given the preference to three, especially in blocks produced by hand processes. In England, though four-colour work is not so general, a fourth printing in black is often resorted to, or one of the trichromatic colours is run twice through to get increased strength.

"An interesting attempt to found a four-colour system of colour printing was the complementary colour process of Mr. C. G. Zander, which was patented in 1905. The inventor assumed that it was necessary to use, not three but four fundamental colours, viz., red, yellow, green, and blue, by mixtures of which in suitable proportions any colours in Nature could be matched or produced. The hues of these four fundamental (or monochromatic) colours may in popular terms be described as magenta red, lemon yellow, emerald green, and ultramarine blue. The four colours were grouped into two pairs of complementary colours, viz., red and green, yellow and blue, so that when the elements of either pair were mechanically mixed as pigments, by printing or staining they produced black. At first sight it might seem that the only difference from the ordinary process was the addition of a green printing colour, but actually the other colours have been scientifically adjusted or readjusted, so that they form two pairs of complementary colours. The author of this process claimed that practically the whole range of the spectrum colours could be produced by it, besides extra-spectral purples, dense pure black, and homogeneous greys. Mr. Zander asserts that no pure black can be reproduced at

all in three-colour printing, whilst by his new process either of the two pairs would produce black or grey. Several specimens were produced by this process, and it certainly appeared capable of rendering more brilliantly the bright colours of flowers, ribbons etc.; but the results were not entirely convincing, probably through the engravers not having sufficient practice with the new method. Printers did not view with favour the idea of a fourth printing, and on the whole the process was received so coldly that the inventor has not pushed it further."

Collotype.

Experiments with a view to using the collotype process for colour printing were made by Albert in Munich and Husnik of Prague in the early seventies, and the State Paper Office in Petrograd was producing colour collotypes by 1878. H. W. Vogel introduced colour-sensitive photographic plates about this time, and prints in collotype by this means were extensively made in Germany in the late eighties. Several firms in England adopted the process about 1890, among them Messrs. Waterlow & Sons. In 1890–91 this firm produced some very excellent work, but the process was not suitable for the English climate, and the introduction of the three-colour half-tone resulted in its abandonment as far as rapid commercial work was concerned. Of recent years collotype colour work has again come to the front, principally on the Continent, although a few English firms have done very well with the process. Messrs. Emery Walker have produced some very fine specimens of collotype in colours, which I am able to show.

During this survey of the recent history of colour printing, we see in the first period the rise of chromo-lithography and its only rival, chromo-xylography. With the exception of a few experiments, these two methods hold their own until the coming of three-colour work about 1890. The triumphal march of the three-colour process, with its accompanying disadvantages of clay-coated paper and fugitive inks, still continues, but there are signs of improvement. The development of the litho offset and photogravure processes are all for the betterment of colour work. The same disadvantages do not apply to them, and so there is a hope that we may presently have a process of colour reproduction that will be accurate, cheap, printed in fast colours, and on paper that will not fall to pieces after a few years or turn into a clay brick if it gets damp.

[Note.—Each lecture was illustrated by lantern-slides and an exhibition of specimens of printing. The exhibits were individually described after the lecture.]

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